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MODIS Correction Algorithm for Out-of-band Response in the Short-wave IR Bands

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ABSTRACT

The MODerate Resolution Imaging Spectroradiometer (MODIS) has 36 spectral bands with wavelengths from 0.41 to 14.2 micrometers. The 36 spectral bands, a total of 490 detectors, are distributed on four focal plane assemblies (FPAs): visible (VIS), near infrared (NIR), short- and mid-wave infrared (SMIR), and long-wave infrared (LWIR). Nearly identical copies of MODIS are currently operating onboard the NASA EOS Terra spacecraft (launched on December 18, 1999) and Aqua spacecraft (launched on May 4, 2002), providing complementing global observations for the studies of the Earth system. Pre-launch and on-orbit characterizations of both Terra and Aqua MODIS instruments have shown small but non-negligible out-of-band (OOB) response in the sensors' short-wave infrared bands (SWIR: Bands 5-7 and 26). To minimize the impact due to OOB response on the MODIS SWIR bands calibration and the Earth scene retrieval, a correction algorithm has been developed and implemented in the Level 1B (L1B) software for both Terra and Aqua MODIS. In this paper, we describe this algorithm and its applications to the MODIS calibration. We will illustrate how the correction coefficients are derived from on-orbit observations and discuss the test procedures involved before algorithm implementation in the L1B code. Actual performance of this algorithm will be evaluated and compared for both Terra and Aqua MODIS.

Keywords: Terra, MODIS, SWIR, short wave infrared bands, out-of-band, calibration, correction, blackbody

1. INTRODUCTION

The MODerate Resolution Imaging Spectroradiometer (MODIS) was designed to make comprehensive global observations for scientific studies of the Earth system. Its ProtoFlight Model (PFM) has been operating onboard the NASA's Earth Observing System (EOS) Terra spacecraft for more than 3 and half years since its launch on December 18, 1999. Terra spacecraft maintains a sun-synchronous polar orbit at an altitude of 705km that descends across the equator at 10:30 a.m. local time. It is also called EOS AM spacecraft because of its morning equator crossing time. The MODIS Flight Model 1 (FM1) onboard the Aqua (also called the EOS PM) spacecraft was launched on May 4, 2002 in an ascending orbit of the same altitude of 705km at 1:30 p.m. equatorial crossing time. The Terra MODIS instrument nadir aperture door opened on February 24, 2000 and Aqua MODIS on June 24, 2002. About 40 science products are currently derived and produced from MODIS 36 spectral bands Level 1B calibrated data sets in the spectral regions from visible (VIS) to long-wave infrared (LWIR), including atmosphere profiles, snow and ice cover, land surface properties, ocean color, and sea surface temperature[1-5].

The MODIS Level 1B software, converting sensor's response in digital numbers to the calibrated top of the atmosphere (TOA) reflectance or radiance products, is developed and maintained by the MODIS Characterization Support Team (MCST). Since the quality of higher-level science products strongly depends on the instrument's calibration and actual on-orbit performance, extensive efforts have been made by the MCST to calibrate and characterize both Terra and Aqua MODIS instruments, pre-launch and on-orbit, and to closely monitor their on-orbit operation. Overall, both MODIS instruments have been performing well on-orbit[6].

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